ISSN 1825-0211

THE WILLINGNESS TO PAY FOR RENEWABLE ENERGY SOURCES (RES): THE CASE OF ITALY WITH DIFFERENT SURVEY APPROACHES AND UNDER DIFFERENT EU "CLIMATE VISION". FIRST RESULTS

Simona BIGERNA — Paolo POLINORI

Quaderno n. 58 — Maggio 2008

QUADERNI DEL DIPARTIMENTO DI ECONOMIA, FINANZA E STATISTICA

The willingness to pay for Renewable Energy Sources (RES): the case of Italy with different survey approaches and under different EU “climate vision”. First results

*Simona BIGERNA - Paolo POLINORI**

**Assistant Professor of Economics*
Department of Economic, Finance and Statistics
Faculty of Political Science
University of Perugia

E-mail: polpa@unipg.it
simonabigerna@unipg.it

Abstract

In reference to the “Renewable Sources” EU Directive 2001/77/CE the Italian goal, for 2010, is to attain the share of 22% in RES electricity production. In such context it becomes crucial to explore the existence of consumer’s Willingness to Pay (WTP) in order to use green energy in the electricity production. This study is founded on a national survey with 1601 phone interviews made, in Italy, at the end of November 2006. This paper focus much on three issues. First one, how the different elicitation affects respondents choices, second one on the relationship between a “single point value” and “a valuation distribution” and finally on the gaps between different formats as: bidding game and dichotomous referendum (single bounded) contingent valuation method. In all the elicitations formats we make a “certainty correction” proposing five degree of acceptance: definitely yes and no (DY, DN), probably yes and no (PY, PN) and don’t know (DK). In order to apply the quantitative analysis, the original dataset has been appropriately treated, recoding DK, PN and PY responses. With regard to the results we found a significant path dependences in respondents answers due to the elicitation formats. Another important result is that also in “conservative” way we found a substantial willingness of consumers to partially cover the cost of Italian RES goal.

Key words: bidding game, contingent valuation, renewable energy sources, descending and ascending elicitation format.

Introduction[1]

Energy situations in many developed countries is bad and getting worse. In the past much of emphasis on climate change action has been based on the precautionary principle; now population awareness has increased and it is more widely accepted that climate change and resource depletion are a real issue to be dealt with.

In this context renewable energy sources (RES) are considered to be environmental sound from the viewpoint of dangerous emissions and resources preservation, consequently scholars and researchers have increased their interest in the economic implication of an development of RES use in electricity production. Also in Italy public interest in RES have lately arose. The expectations in public opinion concern the ability of this new efficient technologies in order to reduce carbon-dioxide emission and to slow resource depletion.

On the supply-generation side the Italian situation have been very complex. Before 2005 there was a commercial interest only in wind energy production but since 2005, among different sources after the initial diffusion of wind farms, photovoltaic technology is approaching the stage of commercial operation narrowing the gap by comparison with wind power generation technology; in addition, recently biomass energy have been also regarded as potential energy sources and studies have been carried out on the future exploitation of this RES.

But one important feature of the RES is their high supply-generation cost and this characteristic has two important consequences on public opinion. Firstly this high cost prevents the widespread uptake of renewable energy systems in spite of their

[1] The authors are thankful to Prof. C. A. Bollino with whom we developed many of the ideas presented in this paper. We also thank Prof. G. Martino and the 27th USAEE/IAEE North American Conference participants for their helpful suggestions. The authors gratefully acknowledge the support of the GSE, Rome, Italy. The usual disclaimer applies.

environmental soundness and consequently, if there is not an actual willingness to pay in the consumers, there is need of public funding in order to support RES development. Otherwise, we assume that if consumers regard some environmental problems as important and think that promoting RES use will mitigate environmental damages, they are likely to attach a value to these RES. Therefore, insofar as consumers think positively of renewable energy technologies, this attitude will influence their willingness to pay (WTP), augmenting the premiums they are potentially apt to pay for such new technology and consequently will, potentially, reduce the needed amount of public funding.
Now, from the energy scenario point of view, the institutional and political Italian setting have brought new aims in compliance with the European Union consequently, in reference to the "Renewable Sources" EU Directive 2001/77/CE, the Italian goal, for 2010 is to attain the share of 22% in RES electricity production. Even in early 2007, UE new goals, namely 20-20-20, have indicated 20% of total energy resources by year 2020, together with a 20% goal of energy savings, so in such setting it has became crucial to explore the existence of Italian consumer's WTP in order to use "green energy" in the electricity production.
Consistently with this Italian energy scenario the primary purpose of this study is to estimate consumers' WTP for the development of the RES use in Italy by bidding game (BG) method. This method allows us to consider that consumers have, potentially, a range of economic values, or a valuation distribution in their mind instead of a single point economic value estimation.
In our framework we obtain the consumer's WTP with two different approaches (downward *vs.* upward) consequently our aim is twofold.
Firstly we focus much on the different elicitation formats and then we pay attention on the different uncertainty degree that affects respondents choices. Finally we wish to estimate the market sustainability of the 22% Italian goal in renewable electricity production.
The setup of this paper is as follows: section 1 briefly reviews the theoretical background, section 2 shows the methodology approach while section 3 sets out some detail on survey design and on data description; section 4 refers to empirical study and presents results from regression analysis; further discussion on the empirical results and their policy implications is provided in the final section.

1. Background

The willingness-to-pay technique is being used increasingly to evaluate environmental benefits in financial terms when markets do not exist to provide information necessary for conducting benefit-cost analysis; obviously, this is the case of RES use development. Indeed, on the use of RES several surveys have been performed in the United States (Farhar, 1999; Roe, et al. 2001; Vossler et al. 2003), United Kingdom (Batley et al. 2001), Australia (Ivanova, 2004) Spanish (Alvarez-et al. 2002) and Japan (Nomura and Akay, 2004). As far as we know in Italy, only one survey (Bollino and Polinori, 2006, 2007) has been performed and data have been collected to draw suggestions about consumers energy sources preferences.
Even if these studies are not very comparable because they differs in terms of: i) survey periods; ii) countries and institutional context; iii) survey typology; iv) elicitation formats, v) applied methodology and econometric techniques; it can be however

useful summarize their empirical results in order to systematize the different results in terms of policy implications.
Generally prior studies founded a contained consumer's WTP if compared with the additional cost due to the National policy energy goal. This is, for example, in Ivanova study (2004) for Queensland and in Batley economic analysis (et al. 2001) for UK.
In detail, Ivanova (2004) analysis is a traditional contingent variation surveying 820 respondents in the State of Queensland (Australia), via mail questionnaire, obtaining an overall response rate of 26%. Main objective is to evaluate market sustainability of the Federal Government Renewable Energy Target (RET), which sets minimum electric energy production share to be generated from RES, in terms of consumers WTP. Results show that 65% of respondents are willing to pay 22 Australian Dollars per quarter, in order to increase RES use from 10 to 12%. This result, however, shows that Government RET target would not be attainable only with market approach. For U.K., Batley (et al. 2001) report a relatively smaller WTP in their study performed via mail questionnaire (2250 sent, in 1997, response rate 27,2%). Results show that 34% of respondents declares to be willing to pay and additional 16,6% of their actual expenditure, in order to have electricity from RES; according to authors, this is anyway insufficient to eventually achieve a national target of 10% production from RES. In literature others studies confirm these results. Nomura et al (2004) investigate WTP to increase electricity production from RES, via mail questionnaire (response rate 37%), in several japans cities (11 large metropolitan areas and numerous medium and small municipalities). Results estimate consumer WTP about 2000 yen per month, one of the highest estimates relative to other studies conducted n Japan. Finally also in Italy, recent estimates of WTP for RES are variable and show a range estimate between 24 and 54 € yearly per household. Analysis has been conducted with payment card method, but estimated WTP almost doubles when using contingent valuation method (Bollino and Polinori, 2006, 2007).

2. The method

In this study we consider Italian as typical consumers in that they maximize utility subject to constraints. The demand for "RES use" can be viewed as any other good or service and therefore modelled within the utility (expenditure) maximization (minimization) framework.

$$E(R, Z) \quad (1)$$
$$\text{sub. to } U = U(R, Z). \quad (2)$$

Faced with expenditures for both "RES use" services (R) and a composite good (Z) subject to the utility constraint, the consumer will attempt to minimize the following expenditure function:

$$E^* = E(P_R, P_Z, U) \quad (3)$$

However, given the characteristic of RES it makes sense to think of this as a restricted demand problem where the consumer does not observe P_R and choose R, but rather is offered R and can choose to pay for it or not. Therefore, P_R is replaced with R and then we can rewrite the expenditure function as follows:

$E^* = E(R, P_Z, U)$ (4)

In this restricted case, the WTP for "RES use" is simply the difference between two expenditure functions with $R_1 > R_0$ and the compensating surplus welfare estimate can be derived from the following difference.

$CS(W_0;W_1) = E(R_0, P_Z, U_0) - E(R_1, P_Z, U_0)$ (5)

This estimate of compensating surplus is a measure of the WTP for "RES use" service. It is the amount that each Italian household is willing to give up and still remain at the previous utility level before the change.
Obviously we can think of this WTP as a function of socio-demographic characteristics of respondents and we will consider this aspect in the course of the research program but not in this paper.

3. The data

In order to derive actual estimates of WTP a national survey with 1601 phone interviews was administrated at the end of November 2006. The stratified sample is representative of 46.8 million individuals, residents of Italy, and the survey was conducted by Istituto Piepoli[2]. Each respondent was confronted with a range of:

i) general questions on RES and their potential development;
ii) questions on knowledge about Italian energy system;
iii) money amounts (bids), ranking from 5€ to 20€[3] per electricity bill (bymonthly), with increments by 5€, in order to support RES development in Italy;

Table 1 fully provides sample characteristics and it shows that the sample is highly representative of Italian Population in terms of male-female ratio, geographical and urban location, demographic characteristics, education and income distribution.
Figures 1 and 2 show the statistics of "Knowledge variables", in other words we investigate if respondents have or have not a deep knowledge of the RES. In the overall sample (Figure 1) 79% answered that to know RES while 21% affirmed that they do not know any RES. Really this is only a general and shallow knowledge, indeed Figure 2 highlights that respondents haven't this accurate knowledge.
Among the respondents (Figure 2) most famous RES are Solar power, Hydro and Wind Power while are little-known biomasses and Geothermal power.

[2] Survey was not performed ad hoc. This Survey Company uses CATI method to conduct a routinely week survey, and specific questions on environment were added to this survey; this last feature shows the high degree of accuracy in estimating Italian population socio-demographic characteristics because of large experience of interviewers. Authors was able to interact with Survey staff, in order to define language of questionnaire. Full raw data set was transferred to author for this elaboration, so in principle no hidden non-stochastic distortion (such as recoding mistakes) should affect results.
[3] To test the validity of these bids we presented them to two focus groups. The first one had 25 people including energy economists, electrical engineers and environmentalists while the second one was more varied including retired people, housewives, managers and students. Firstly we presented the research to the groups and then we asked them their WTP using an open ended elicitation format.

A very important result concerns sample favourable attitude on RES: indeed 47.3% of respondents declare a positive WTP in order to increase the use of RES in energy production while 15% are undecided.
Table 2 shows location and scale parameters of more important variables. The representative respondent is a woman aged 47 highly educated with one children. The family income is around 29,000 € and the family is home owner. About the topic of the survey the representative respondent believes that the Italian energy scenario will lot worse in the next ten years and he believes to know the RES but really his knowledge isn't so accurate.

Table 1: Survey respondent (1601 Obs.) and Country (Italy) resident characteristics

Variables	Survey Respondents	Country Residents
- Gender [(a)]		
Male	47.97%	48.40%
Female	52.03%	51.60%
- Macro regions [(a)]		
North-West	27.05%	26.21%
North-East	18.86%	18.66%
Center	19.68%	19.14%
South (with Sic, Sar)	34.42%	36.00%
- Municipality size[(a)]		
<10000	33.29%	32.69%
10-30000	21.49%	22.81%
30-100000	20.42%	21.29%
>100000	24.80%	23.21%
- Age[(a)]		
<25	10.81%	13.07%
25-34	18.36%	17.98%
35-44	18.43%	17.77%
45-54	16.36%	15.52%
55-64	18.05%	13.89%
> 64	17.99%	21.77%
- Education[(a)]		
None and Primary School	20.05%	31.16%
Secondary School and Professional training	45.16%	32.50%
High School	26.80%	29.30%
University or /and higher degree	8.00%	7.04%
- Income (€)[(b)]		
Mean	28658.80	24893.70
Centili - 10%	9822.22	8918.90
25%	14801.18	13175.46
50%	24682.57	20152.32
75%	34088.30	30998.86
90%	47981.99	44049.82
- Professional status[(a)]		
Enterprises		1.36%
Professional class	6.32%	1.83%
Cooperative members		1.36%
Self employed	5.70%	6.92%
Civil servant and earning employee	33.27%	31.45%
Unemployed workers	4.05%	5.62%
Students	12.44%	11.34%
Housewifes	13.38%	15.30%
Pensioners	23.89%	20.64%
Others	0.96%	4.17%
- Household size[(a)] *(members)*		
1	9.31%	24.89%
2	22.99%	27.08%
3	25.92%	21.58%
4	30.98%	18.96%
5	8.56%	5.80%
6 or more	2.25%	1.69%

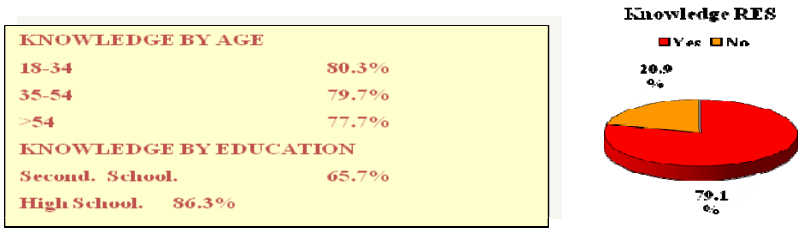


Figure 1: Knowledge of RES (part I)

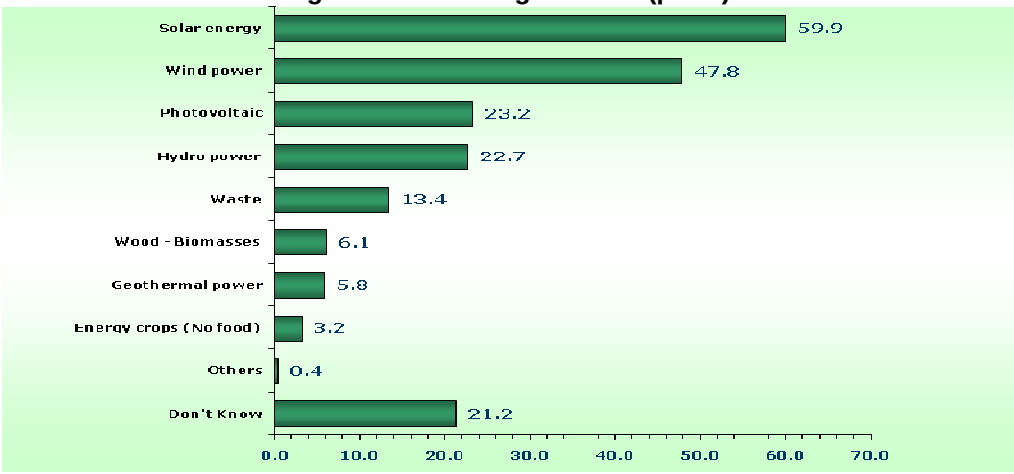


Figure 2: Knowledge of RES (part II)

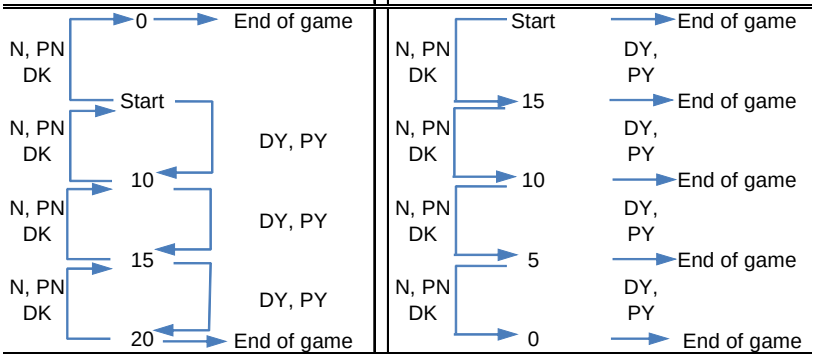
Table 2: Descriptive Statistics

Variable name	Sample (1601 Obs.) Description of variable	Mean value and *St. Dev.*
age	*Age of a respondent*	47.65
	(Continuos variable)	*17.54*
sex	*Sex of a respondent*	1.52
	(1=male; 2= female)	*0.50*
yhat	*Household yearly*	28658.80
	income (€)	*7958.81*
n_compp	*Household size*	3.10
	(Nr.of members)	*1.22*
year_sch	*Number of years a*	12.02
	respondent attended a school	*3.98*
scenario	*In your view the current Italian energy*	1.55
	situation will worsen in the next 10 years?	*0.94*
	(1= a lot …. 4= not at all; 5= dk)	
child	*Number of childrens*	1.35
		1.04
house_hat	*If family is owner of the house*	0.33
	(0 = owner; 1 = otherwise)	*0.47*
knowl_1	*General Knowledge of RES*	1.21
	(1 = wrong; 2 = correct)	*0.41*
kno3_degr	*Accurate Knowledge of different RES*	0.35
	(0 = wrong; 1 = correct	*0.22*

In the last section of the survey questionnaire I obtain the consumer's WTP by two different elicitation formats and to this end, the sample is divided in two part.
In the first sub-sample (808 respondents), bidding game price vector was proposed to respondent, in downward elicitation format: it consists of 5 bids, from 20 to 0 euro per household per bimonthly bill.

In the second sub-sample (793 respondents) I use the same vector with a upward elicitation format (from 0 to 20 euro).
In all the elicitations formats I make a “certainty correction” proposing five language description of acceptance intensity: “definitely yes” and “no” (DY, DN), “probably yes” and “no” (PY, PN) and “not sure or don’t know” (DK). Figure 3 shows, in detail, the elicitation format structure.
As with any contingent valuation study there are always issues of potential bias. However, it has also been shown in the literature that well-designed and carefully administered surveys can provide consistent, sensible, and believable information on willingness to pay. In addition one of the advantages of this data set is that I can formally test for differences across the formats to see if one or any of them is providing significantly different estimates of WTP.

Figure 3: Elicitation format



It is also important to underline that this data set can be useful handling in order to estimate other models. In other words, in order to apply the quantitative analysis, the original dataset has been appropriately treated, recoding DK, PN and PY responses. In detail six different ways were used (A – F models in table 3) to encode the likelihood answers from the bidding games as yes/no/not-sure answers in order to generate a referendum CV sample for the WTP estimation. For example if the respondents is faced to 15 € in ascending format and his answer is PY while the answer is DK or PN or DN when he is faced to 20 € we assume that the responses likelihood answers is: 5 (100%); 10 (100%); 15 (75%); 20 (50% or 25% or 0%). Similarly if the respondent is faced to 10 € in descending format and his answer is PY, after two PN responses, we assume the following likelihood answers: 20 (25%); 15 (25%); 10 (75%); 5 (100%).

Table 3: Data treatment

Method	Treatment
A	DY as Yes PY/DK/ PN as DK DN as No
B	DY/PY as Yes PN/DN as No
C	No treatment
D	DY as Yes Others as No
E	DY/PY as Yes Others as No
F	DY/PY/DK as Yes Others as No

4. Empirical findings

4.1 Willingness to pay.

Rather than jump directly to the regression analysis, it is useful to look first at some non-parametric analysis of willingness to pay.

Preliminary results of the bidding game survey are presented in Figure 4. In the first sub sample, respondents are faced with downward order. We notice that 33% of respondents are willing to pay a 20 euro increase in the cost of electricity bill, 38% would accept to pay 15 €, 49% have a WTP equal to 10 euro per a bill while 62% willing to pay no more than 5 €. In the second sub-sample respondents are faced with upward order. In this case 61% have a WTP equal to 5€, 30% are willing to pay 15 € per bill the electricity produced by RES while 14% are willing to pay 15 €. Finally, only 9% would accept to pay 20 euro.

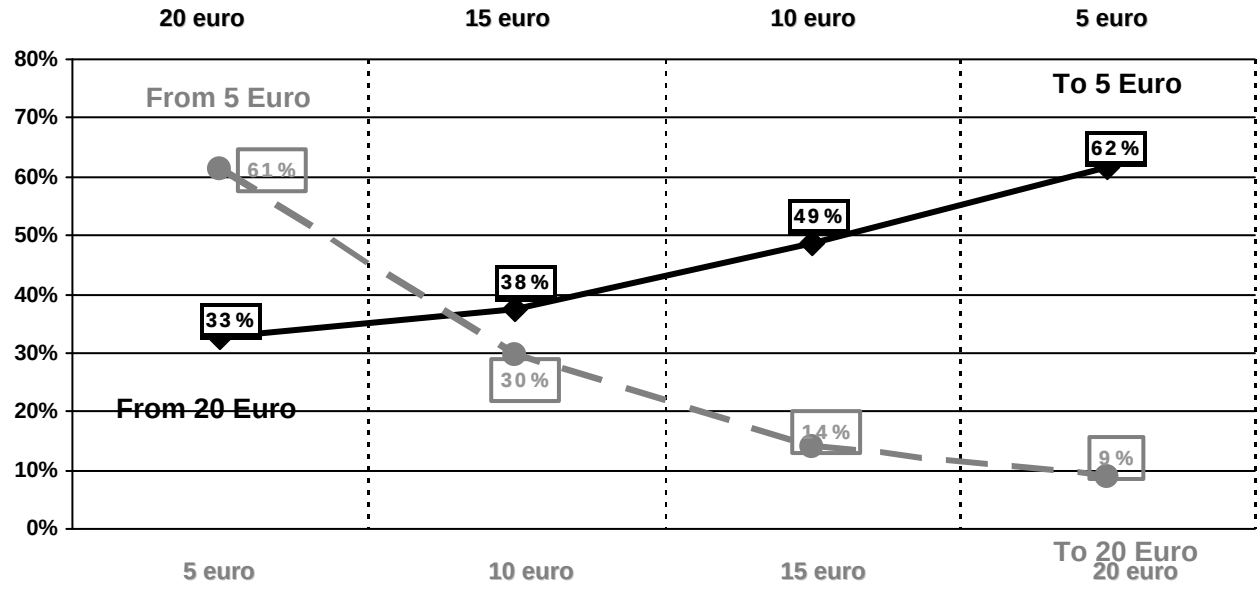


Figure 4: the descriptive results of the survey.

The Figure 4 shows that as we move from 5€ to 10€ the percentage decrease of 31% while when we move from 10 to 5 € the percentage increase only of 13%. In the next step the difference between the two format is smaller. When we move in ascending format from 10 € to 15 € the percentage decrease of 16% while when we move from 15 to 10 € the percentage increase of 11%.

Finally the percentage decreases of 5% when we move from 15€ to 20E and similarly the percentage increase of the same amount when we move from 20 € to 15€ in ascending order. In order to investigate the elicitation effect I also perform an proportion test; indeed if answers are truthful and free of psychological bias the expectations is:

$$P(Y_t|Asc) - P(Y_t|Desc) = 0 \quad (6)$$

where $P(Y_t|Asc)$ is the probability of Yes at t bid in ascending order and $P(Y_t|Desc)$ is the Yes probability at t bid in descending order. In other words under the H_0 there is

the same proportion of respondents in each of five intervals without regard the bid sequence. Tables 4 and 5 show that it is necessary to reject H_0 in several cases coherently with others researches.
The results confirm that with a few rare exceptions there are always different proportions, consequently exist path dependences in WTP estimate.

Table 4: Proportions test -Case I: Overall proportions-

Models	Var.	Mean	Std. Er.	Sign.
D	***Pro(Y/As)***	***0.1308***	***0.0060***	
	Pro(Y/Ds)	***0.1408***	***0.0061***	
	Diff. In Prob	***-0.0099***	***0.0086***	
	H0	***Diff=0***		***n.s.***
E	Pro(Y/As)	0.2847	0.0080	
	Pro(Y/Ds)	0.4489	0.0087	
	Diff. In Prob	-0.1643	0.0119	
	H0	Diff=0		***
F	Pro(Y/As)	0.3241	0.0083	
	Pro(Y/Ds)	0.4824	0.0088	
	Diff. In Prob	-0.1583	0.0121	
	H0	Diff=0		***

Note: .01 - ***; .05 - **; .1 - *; Mod D: Yes = DY;
Mod. E: Yes = DY + PY; Mod. F: Yes = DY + PY + DK

Table 5: proportions test -Case II: Single bid proportions-

Models	Bids	Var.	Mean	Std. Er.	Sign.	Models	Bids	Var.	Mean	Std. Er.	Sign.	Models	Bids	Var.	Mean	Std. Er.	Sign.
D	5	Pro(Y/As)	0.3064	0.0164		***E***	***5***	***Pro(Y/As)***	***0.6129***	***0.0173***		**F**	**5**	***Pro(Y/As)***	***0.6494***	***0.0169***	
		Pro(Y/Ds)	0.1795	0.0135				***Pro(Y/Ds)***	***0.6126***	***0.0171***				***Pro(Y/Ds)***	***0.6448***	***0.0168***	
		Diff. In Prob	0.1270	0.0212				***Diff. In Prob***	***0.0002***	***0.0243***				***Diff. In Prob***	***0.0046***	***0.0239***	
		H0	Diff=0		***			***H0***	***Diff=0***		***n.s.***			***H0***	***Diff=0***		**n.s.**
D	***10***	***Pro(Y/As)***	***0.1299***	***0.0119***		E	10	Pro(Y/As)	0.2963	0.0162		F	10	Pro(Y/As)	0.3417	0.0168	
		Pro(Y/Ds)	***0.1411***	***0.0122***				Pro(Y/Ds)	0.4827	0.0176				Pro(Y/Ds)	0.5099	0.0176	
		Diff. In Prob	***-0.0112***	***0.0171***				Diff. In Prob	-0.1863	0.0239				Diff. In Prob	-0.1682	0.0244	
		H0	***Diff=0***		***n.s.***			H0	Diff=0		***			H0	Diff=0		***
D	15	Pro(Y/As)	0.0530	0.0080		E	15	Pro(Y/As)	0.1412	0.0124		F	15	Pro(Y/As)	0.1803	0.0137	
		Pro(Y/Ds)	0.1225	0.0115				Pro(Y/Ds)	0.3738	0.0170				Pro(Y/Ds)	0.4109	0.0173	
		Diff. In Prob	-0.0696	0.0140				Diff. In Prob	-0.2325	0.0210				Diff. In Prob	-0.2306	0.0220	
		H0	Diff=0		***			H0	Diff=0		***			H0	Diff=0		***
D	20	Pro(Y/As)	0.0340	0.0064		E	20	Pro(Y/As)	0.0883	0.0101		F	20	Pro(Y/As)	0.1248	0.0117	
		Pro(Y/Ds)	0.1200	0.0114				Pro(Y/Ds)	0.3267	0.0165				Pro(Y/Ds)	0.3639	0.0169	
		Diff. In Prob	-0.0860	0.0131				Diff. In Prob	-0.2385	0.0193				Diff. In Prob	-0.2390	0.0206	
		H0	Diff=0		***			H0	Diff=0		***			H0	Diff=0		***

Note: .01 - ***; .05 - **; .1 - *; Mod D: Yes = DY; Mod. E: Yes = DY + PY; Mod. F: Yes = DY + PY + DK

A great deal of literature has emerged concerning how to calculate overall WTP. Turnbull (1976) originally utilized a measure that provides a lower bound mean (LBM) estimate of WTP that is calculated as follows:

$$LBM = \pi_0(p_0) + \sum_{i=1}^{m} \pi_i (p_i - p_{i-1}) \tag{7}$$

Later Kristrom (1990) recommended a method that offers a higher estimate of WTP for any given data set that is probably more realistic than Turnbull. The Kristrom mean (KM) is defined as:

$$KM = LBM + \frac{1}{2} p_0 (1 - \pi_0) +$$

$$+ \sum_{i=1}^{m} \frac{1}{2} |\pi_i - \pi_{i-1}| \left(p_i - p_{i-1} \right) + \frac{1}{2} \pi_k \left(p^* - p_k \right) \tag{8}$$

where π_i are the percentages who support a given bid p_i; m is the numbers of bid offered after the initial bid p_0 and p^* is the estimated bid price where π falls to zero.
Both Turnbull and Krinstrom measures utilize the data from the survey in order to obtain WTP estimates; table 6 shows the results. We can see that it is the descending bid dichotomous choice format that provides the highest WTP and the highest variance around the mean, while the ascending formats and full sample

display enough close mean WTP and standard deviations around the respective means.

Table 6: WTP non parametric estimate (€ per a bill)				
Method		Discending	Ascending	Full Sample
LMB	Mean	4.25	3.27	3.47
	St. dev	*3.68*	*2.31*	*2.79*
KM	Mean	7.36	5.67	6.01
	St. dev	*6.37*	*4.00*	*4.83*

One of the benefits of this type of analysis is that it helps to hypothesize about expected results from the follow regression analysis. It should come as no surprise that the WTP from descending bid format would have a higher value. These preliminary and descriptive results confirm many previous results (Welsh – Poe, 1998; Vossler et al. 2003, Wang - Whittington, 2005) that underline how the choice of elicitation method can significantly influence estimates.

4.2. Regression analysis

In order to isolate the effect of the two elicitation procedures on the estimated mean WTP, I conducted additional analyses in which I treated the data obtained from the bidding game at a specific price, from 5 to 20, as if it was the individual's answer to a single referendum question. A new data set was thus constructed by randomly assigning a price to each respondent and these new data were then analyzed applying dichotomous choice models and ordered models. Table 7 shows estimate results, for brevity we report only ascending elicitation and full sample results.

Table 7: Estimation of WTP regarding different elicitation formats (Ascending vs. Full Sample)				
Models	A		B	
Likelihood answer treatment	DY as Yes PY/DK/ PN as DK DN as No		DY/PY as Yes DK PN/DN as No	
Modeling method	Ordered probit		Ordered probit	
Elicitation	Ascending	Full Sample	Ascending	Full Sample
Mean WTP	3.93	8.538	5.31	8.126
Conf. Interv. (95%)	*(3.451-4.349)*	*(8.149-8.825)*	*(4.928-5.628)*	*(7.700-8.435)*
Adj R-sq	0.031	0.038	0.040	0.039
LR test (1)	701.131	168.99	618.84	154.56
Obs.	787	1511	787	1511
Models	C		D	
Likelihood answer treatment	No treatment		DY as Yes Others as No	
Modeling method	Ordered probit		Probit	
Elicitation	Ascending	Full Sample	Ascending	Full Sample
Mean WTP	7.83	9.187	1.230	2.438
Conf. Interv. (95%)	*(6.316-9.059)*	*(9.100-9.303)*	*(1.001-1.489)*	*(2.113-2.694)*
Adj R-sq	0.058	0.055	0.041	0.032
LR test (1)	79.55	170.75	297.853	145.24
Obs.	787	1511	787	1511
Models	E		F	
Likelihood answer treatment	DY/PY as Yes Others as No		DY/PY/DK as Yes Others as No	
Modeling method	Probit		Probit	
Elicitation	Ascending	Full Sample	Ascending	Full Sample
Mean WTP	2.49	3.737	4.84	9.393
Conf. Interv. (95%)	*(2.291-2.649)*	*(3.469-3.931)*	*(4.655-4.990)*	*(9.237-9.504)*
Adj R-sq	0.034	0.030	0.082	0.071
LR test (1)	620.40	154.40	573.92	300.24
Obs.	787	1511	787	1511

Table 7 shows that the highest mean WTP obtained is 9.39 € with confidence interval of [9.24 – 9.50], when DY, PY and DK are all treated as DY responses in a referendum model. This estimated mean WTP is not so much higher than the

estimate obtained using “no treated” data, 9.19 €, with a confidence interval of [9.10 – 9.30]. This analysis confirms that the difference in the mean WTP estimates obtained from the different methods is largely due to the elicitation procedure. Finally Table 8 shows the policy implications of the different models with the old EU RES target.

Table 8: Policy implications

Mean WTP (Euro)		Annual electric bill (Nr.)	Households (Nr.)	Total annual WTP (Euro)	Annual subsidy cost (Euro)	Market sustainability of RES (%)	Differences in % (Full - Asc)
Model A Asc.	3.935			514,949,106		**25.75%**	**30.12%**
-- Full	8.538			1,117,376,155		**55.87%**	
Model B Asc.	5.308			694,577,579		**34.73%**	**18.44%**
-- Full	8.126			1,063,416,920		**53.17%**	
Model C Asc.	7.83			1,024,414,977		**51.22%**	**8.89%**
-- Full	9.19	**6**	**21,810,676**	1,202,203,143	**2,000,000,000**	**60.11%**	
Model D Asc.	1.23			160,962,789		**8.05%**	**7.90%**
-- Full	2.44			318,996,898		**15.95%**	
Model E Asc.	2.486			325,298,777		**16.26%**	**8.19%**
-- Full	3.737			489,093,977		**24.45%**	
Model F Asc.	4.838			633,061,793		**31.65%**	**29.81%**
-- Full	9.393			1,229,223,454		**61.46%**	

We can see that the cover capacity range lies between 8% and 51% with ascending elicitation format but more frequently results are around 50% of the annual cost if we consider the WTP estimated using the full sample. Lastly the average loss, that is the difference between Full sample vs. Conservative (Ascending format), is 17% of the cover capacity of annual subside cost with the minimum of 7.9% and the maximum of 30.12%. If we consider the new EU energy efficiency target as “20-20-20” the scenario worsens dramatically. The new target implies a bimonthly additional cost of 40 € for each electricity bill. Under this new “Environmental Regime” the cover capacity is constantly under 25% of the total subsidy cost (see table 9).

Table 9: Policy implications with 20-20-20 target.

Mean WTP (Euro)		Additional cost for each electricity bill (€)	Cover capacity 20-20-20	Differences in % (Full - Asc)
Model A Asc.	3.935		**9.84%**	**11.51%**
-- Full	8.538		**21.35%**	
Model B Asc.	5.308		**13.27%**	**7.05%**
-- Full	8.126		**20.32%**	
Model C Asc.	7.83		**19.57%**	**3.40%**
-- Full	9.19	**40**	**22.97%**	
Model D Asc.	1.23		**3.08%**	**3.02%**
-- Full	2.44		**6.09%**	
Model E Asc.	2.486		**6.21%**	**3.13%**
-- Full	3.737		**9.34%**	
Model F Asc.	4.838		**12.09%**	**11.39%**
-- Full	9.393		**23.48%**	

Table 9 shows that with a restricted (ascending) sample, the market sustainability of the “20-20-20” objective lies between 3% and 19.6% while with the full sample the range values increase until 9.3% to 23.5%.

Conclusions

Concerning policy implication, in previous analysis (Bollino – Polinori, 2006, 2007) the findings support the view that in Italy there is some consensus on the development of RES. In monetary value, this consensus is estimated as 35% of the total subsidy cost. In this paper we use more than one econometric procedure in order to obtain more robust statistical results and, consequently, more relevant policy

indication too. Firstly we found a significant path dependences in respondents answers due to the elicitation formats. Another important result concern that also in conservative way we found a substantial willingness of consumers to partially cover the cost of RES goal. Indeed also with the ascending elicitation format we obtain a cover capacity of the annual cost greater than 30% three models out of six (Models B, C and F). Regrettably, the increasing EU expectation on energy efficiency and CO2 emission reduction will tend to reduce market sustainability of EU Climate vision.

References

Alvarez-Farizo, B., Hanley, N., (2002), Using conjoint analysis to quantify public preferences over the environmental impacts of wind farms. An example from Spain, Energy Policy, 30, 107-116.

Batley S.L. – Colbourne D. – Fleming P.D. – Urwin O. (2001), *Citizen versus consumer: challenges in the UK green power market,* Energy Policy, 29 pp. 479-487.

Bollino C.A. - Polinori P. (2006), *An assessment of consumer willingness to pay for Renewable Energy Sources use in Italy: a payment card approach*, 26th USAEE/IAEE North American Conferences "Energy in a Word of Changing Costs and Technologies", Ann Arbor – Michigan – USA, September 24-27.

Bollino C.A. - Polinori P. (2007), *How much Italians are willing to pay for Renewable Energy Sources. A comparison of two methodological approaches*, *30th Conference OAEE/IAEE,* "*From Restructuring to Sustainability: Energy Policies for the 21st Century*", *Wellington, New Zealand 18-21 February 2007.*

Farhar B.C., (1999), WTP for electricity from renewable resources: a review of utility market research, NREL WP, n. 550.26148.Genius M. – Strazzera E. (2005), *Modelling elicitation effects in contingent valuation studies,* in Scarpa R. – Alberini A. (eds.) *Application and Simulation Methods in Environmental and Resources Economics,* Springer, Dordrecht, Ch. 12, pp. 223-246.

Ivanova G. (2005), *Queensland Consumers' Willingness to Pay for Electricity from Renewable Energy Sources*, Australia New Zeland for Ecological Economics, (anzsee2005papers).

Kristrom, B., (1990), A Non-Parametric Approach to the Estimation of Welfare Measures in Discrete Response Valuation Studies, Land Economics, 66(2), 135-139.

Nomura, N., Akay, M., (2004), WTP for green electricity in Japan as estimated through contingent valuation method, Applied Energy, 78, 453-463.

Roe B. Teisl M. Levy A. and Russel M. (2001), US consumers' WTP for green electricity, Energy policy, 29, 917-925.

Turnbull, B.W., (1976), The Empirical Distribution Function with Arbitrary Grouped, Censored and Truncated Data, Journal Royal Statist. Soc. Ser. B, 38, 290-295.

Vossler C.A. – Ethier R.G. – Poe G.L. – Welsh M.P. (2003), Payment certainty in discrete choice Contingent Valuation responses: result from a field validity test, *Southern Economic Journal,* 69(4), 886-902.

Wang H. – Whittington D. (2005), Measuring individuals' valuation distribution using stochastic payment card approach, *Ecological Economics,* 55, 143-154.

Welsh M.P. – Poe G.L. (1998), Elicitation effects in Contingent Valuation: comparisons to a multiple bounded discrete choice approach, *Journal of Environmental and Management,* 36, 170-185.

QUADERNI DEL DIPARTIMENTO DI ECONOMIA, FINANZA E STATISTICA
Università degli Studi di Perugia

1	Gennaio 2005	Giuseppe CALZONI Valentina BACCHETTINI	Il concetto di competitività tra approccio classico e teorie evolutive. Caratteristiche e aspetti della sua determinazione
2	Marzo 2005	Fabrizio LUCIANI Marilena MIRONIUC	Ambiental policies in Romania. Tendencies and perspectives
3	Aprile 2005	Mirella DAMIANI	Costi di agenzia e diritti di proprietà: una premessa al problema del governo societario
4	Aprile 2005	Mirella DAMIANI	Proprietà, accesso e controllo: nuovi sviluppi nella teoria dell'impresa ed implicazioni di corporate governance
5	Aprile 2005	Marcello SIGNORELLI	Employment and policies in Europe: a regional perspective
6	Maggio 2005	Cristiano PERUGINI Paolo POLINORI Marcello SIGNORELLI	An empirical analysis of employment and growth dynamics in the italian and polish regions
7	Maggio 2005	Cristiano PERUGINI Marcello SIGNORELLI	Employment differences, convergences and similarities in italian provinces
8	Maggio 2005	Marcello SIGNORELLI	Growth and employment: comparative performance, convergences and co-movements
9	Maggio 2005	Flavio ANGELINI Stefano HERZEL	Implied volatilities of caps: a gaussian approach
10	Giugno 2005	Slawomir BUKOWSKI	EMU – Fiscal challenges: conclusions for the new EU members
11	Giugno 2005	Luca PIERONI Matteo RICCIARELLI	Modelling dynamic storage function in commodity markets: theory and evidence
12	Giugno 2005	Luca PIERONI Fabrizio POMPEI	Innovations and labour market institutions: an empirical analysis of the Italian case in the middle 90's
13	Giugno 2005	David ARISTEI Luca PIERONI	Estimating the role of government expenditure in long-run consumption
14	Giugno 2005	Luca PIERONI Fabrizio POMPEI	Investimenti diretti esteri e innovazione in Umbria
15	Giugno 2005	Carlo Andrea BOLLINO Paolo POLINORI	Il valore aggiunto su scala comunale: la Regione Umbria 2001-2003
16	Giugno 2005	Carlo Andrea BOLLINO Paolo POLINORI	Gli incentivi agli investimenti: un'analisi dell'efficienza industriale su scala geografica regionale e sub regionale

17	Giugno 2005	Antonella FINIZIA Riccardo MAGNANI Federico PERALI Paolo POLINORI Cristina SALVIONI	Construction and simulation of the general economic equilibrium model Meg-Ismea for the italian economy
18	Agosto 2005	Elżbieta KOMOSA	Problems of financing small and medium-sized enterprises. Selected methods of financing innovative ventures
19	Settembre 2005	Barbara MROCZKOWSKA	Regional policy of supporting small and medium-sized businesses
20	Ottobre 2005	Luca SCRUCCA	Clustering multivariate spatial data based on local measures of spatial autocorrelation
21	Febbraio 2006	Marco BOCCACCIO	Crisi del welfare e nuove proposte: il caso dell'unconditional basic income
22	Settembre 2006	Mirko ABBRITTI Andrea BOITANI Mirella DAMIANI	Unemployment, inflation and monetary policy in a dynamic New Keynesian model with hiring costs
23	Settembre 2006	Luca SCRUCCA	Subset selection in dimension reduction methods
24	Ottobre 2006	Sławomir I. BUKOWSKI	The Maastricht convergence criteria and economic growth in the EMU
25	Ottobre 2006	Jan L. BEDNARCZYK	The concept of neutral inflation and its application to the EU economic growth analyses
26	Dicembre 2006	Fabrizio LUCIANI	Sinossi dell'approccio teorico alle problematiche ambientali in campo agricolo e naturalistico; il progetto di ricerca nazionale F.I.S.R. – M.I.C.E.N.A.
27	Dicembre 2006	Elvira LUSSANA	Mediterraneo: una storia incompleta
28	Marzo 2007	Luca PIERONI Fabrizio POMPEI	Evaluating innovation and labour market relationships: the case of Italy
29	Marzo 2007	David ARISTEI Luca PIERONI	A double-hurdle approach to modelling tobacco consumption in Italy
30	Aprile 2007	David ARISTEI Federico PERALI Luca PIERONI	Cohort, age and time effects in alcohol consumption by Italian households: a double-hurdle approach
31	Luglio 2007	Roberto BASILE	Productivity polarization across regions in Europe
32	Luglio 2007	Roberto BASILE Davide CASTELLANI Antonello ZANFEI	Location choices of multinational firms in Europe: the role of EU cohesion policy
33	Agosto 2007	Flavio ANGELINI Stefano HERZEL	Measuring the error of dynamic hedging: a Laplace transform approach

34	Agosto 2007	Stefano HERZEL Cătălin STĂRICĂ Thomas NORD	The IGARCH effect: consequences on volatility forecasting and option trading
35	Agosto 2007	Flavio ANGELINI Stefano HERZEL	Explicit formulas for the minimal variance hedging strategy in a martingale case
36	Agosto 2007	Giovanni BIGAZZI	The role of agriculture in the development of the people's Republic of China
37	Settembre 2007	Enrico MARELLI Marcello SIGNORELLI	Institutional change, regional features and aggregate performance in eight EU's transition countries
38	Ottobre 2007	Paolo NATICCHIONI Andrea RICCI Emiliano RUSTICHELLI	Wage structure, inequality and skill-biased change: is Italy an outlier?
39	Novembre 2007	The International Study Group on Exports and Productivity	Exports and productivity. Comparable evidence for 14 countries
40	Dicembre 2007	Gaetano MARTINO Paolo POLINORI	Contracting food safety strategies in hybrid governance structures
41	Dicembre 2007	Floro Ernesto CAROLEO Francesco PASTORE	The youth experience gap: explaining differences across EU countries
42	Gennaio 2008	Melisso BOSCHI Luca PIERONI	Aluminium market and the macroeconomy
43	Febbraio 2008	Flavio ANGELINI Marco NICOLOSI	Hedging error in Lévy models with a fast Fourier Transform approach
44	Febbraio 2008	Luca PIERONI Giorgio d'AGOSTINO Marco LORUSSO	Can we declare military Keynesianism dead?
45	Febbraio 2008	Pierluigi GRASSELLI Cristina MONTESI Paola IANNONE	Mediterranean models of Welfare towards families and women
46	Marzo 2008	Mirella DAMIANI Fabrizio POMPEI	Mergers, acquisitions and technological regimes: the European experience over the period 2002-2005
47	Marzo 2008	Bruno BRACALENTE Cristiano PERUGINI	The Components of Regional Disparities in Europe
48	Marzo 2008	Cristiano PERUGINI Fabrizio POMPEI Marcello SIGNORELLI	FDI, R&D and Human Capital in Central and Eastern European Countries
49	Marzo 2008	Cristiano PERUGINI	Employment and Unemployment in the Italian Provinces
50	Marzo 2008	Sławomir I. BUKOWSKI	On the road to the euro zone. Currency rate stabilization: experiences of the selected EU countries
51	Aprile 2008	Bruno BRACALENTE Cristiano PERUGINI Fabrizio POMPEI	Homogeneous, Urban Heterogeneous, or both? External Economies and Regional Manufacturing Productivity in Europe

52	Aprile 2008	Gaetano MARTINO Cristiano PERUGINI	Income inequality within European regions: determinants and effects on growth
53	Aprile 2008	Jan L. BEDNARCZYK	Controversy over the interest rate theory and policy. Classical approach to interest rate and its continuations
54	Aprile 2008	Bruno BRACALENTE Cristiano PERUGINI	Factor decomposition of cross-country income inequality with interaction effects
55	Aprile 2008	Cristiano PERUGINI	Employment Intensity of Growth in Italy. A Note Using Regional Data
56	Aprile 2008	Cristiano PERUGINI Fabrizio POMPEI	Technological Change, Labour Demand and Income Distribution in European Union Countries
57	Aprile 2008	Simona BIGERNA Paolo POLINORI	L'analisi delle determinanti della domanda di trasporto pubblico nella città di Perugia
58	Maggio 2008	Simona BIGERNA Paolo POLINORI	The willingness to pay for Renewable Energy Sources (RES): the case of Italy with different survey approaches and under different EU "climate vision". First results

ISSN 1722-618X

I QUADERNI DEL DIPARTIMENTO DI ECONOMIA
Università degli Studi di Perugia

1	Dicembre 2002	Luca PIERONI:	Further evidence of dynamic demand systems in three european countries
2	Dicembre 2002	Luca PIERONI Paolo POLINORI:	Il valore economico del paesaggio: un'indagine microeconomica
3	Dicembre 2002	Luca PIERONI Paolo POLINORI:	A note on internal rate of return
4	Marzo 2004	Sara BIAGINI:	A new class of strategies and application to utility maximization for unbounded processes
5	Aprile 2004	Cristiano PERUGINI:	La dipendenza dell'agricoltura italiana dal sostegno pubblico: un'analisi a livello regionale
6	Maggio 2004	Mirella DAMIANI:	Nuova macroeconomia keynesiana e quasi razionalità
7	Maggio 2004	Mauro VISAGGIO:	Dimensione e persistenza degli aggiustamenti fiscali in presenza di debito pubblico elevato
8	Maggio 2004	Mauro VISAGGIO:	Does the growth stability pact provide an adequate and consistent fiscal rule?
9	Giugno 2004	Elisabetta CROCI ANGELINI Francesco FARINA:	Redistribution and labour market institutions in OECD countries
10	Giugno 2004	Marco BOCCACCIO:	Tra regolamentazione settoriale e antitrust: il caso delle telecomunicazioni
11	Giugno 2004	Cristiano PERUGINI Marcello SIGNORELLI:	Labour market performance in central european countries
12	Luglio 2004	Cristiano PERUGINI Marcello SIGNORELLI:	Labour market structure in the italian provinces: a cluster analysis
13	Luglio 2004	Cristiano PERUGINI Marcello SIGNORELLI:	I flussi in entrata nei mercati del lavoro umbri: un'analisi di cluster
14	Ottobre 2004	Cristiano PERUGINI:	Una valutazione a livello microeconomico del sostegno pubblico di breve periodo all'agricoltura. Il caso dell'Umbria attraverso i dati RICA-INEA
15	Novembre 2004	Gaetano MARTINO Cristiano PERUGINI	Economic inequality and rural systems: empirical evidence and interpretative attempts
16	Dicembre 2004	Federico PERALI Paolo POLINORI Cristina SALVIONI Nicola TOMMASI Marcella VERONESI	Bilancio ambientale delle imprese agricole italiane: stima dell'inquinamento effettivo